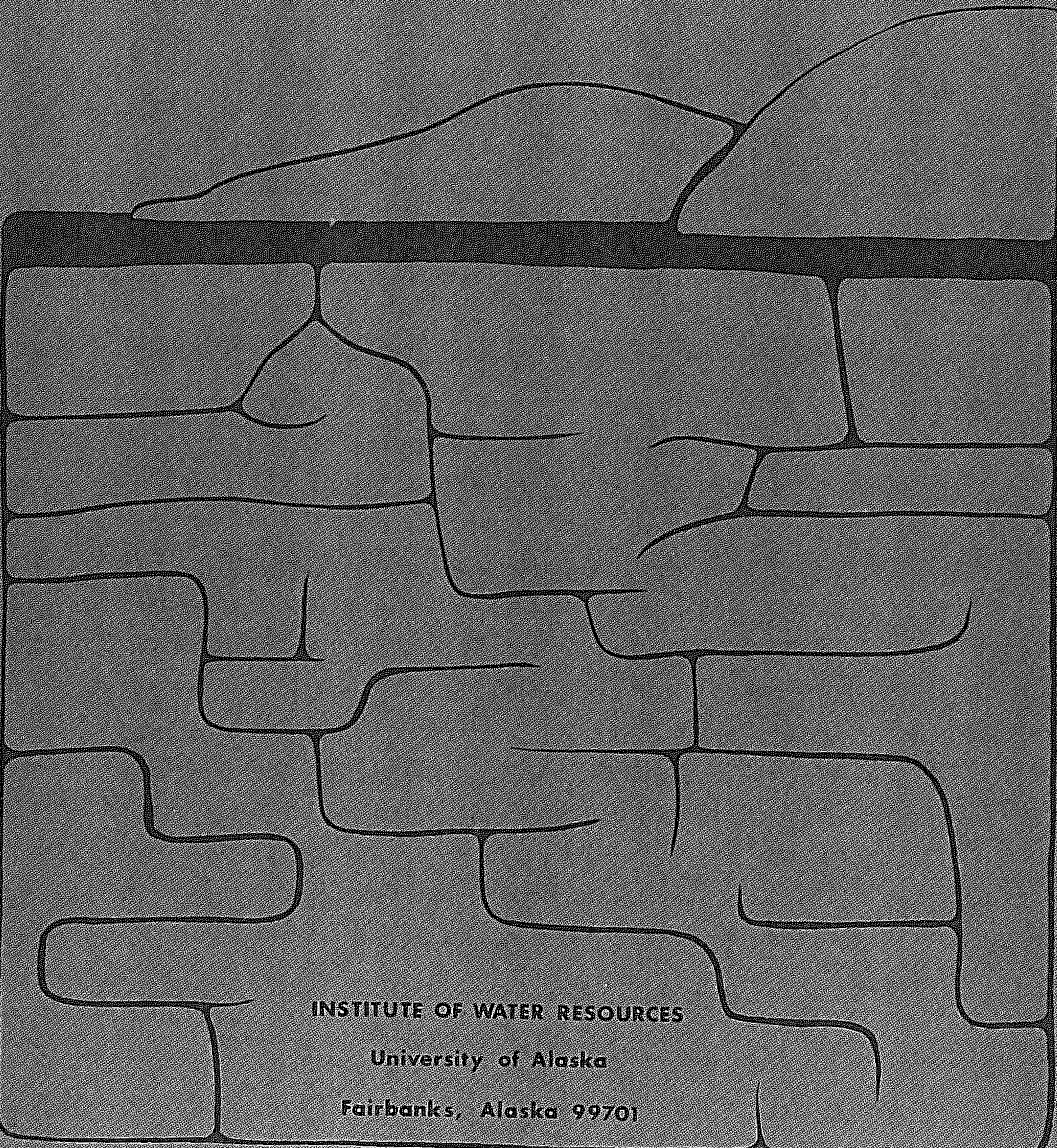
# EVALUATION OF THE TROPHIC TYPES OF SEVERAL ALASKAN LAKES BY ASSESSMENT OF THE BENTHIC FAUNA




INSTITUTE OF WATER RESOURCES

University of Alaska

Fairbanks, Alaska 99701

# EVALUATION OF THE TROPHIC TYPES OF SEVERAL ALASKAN LAKES BY ASSESSMENT OF THE BENTHIC FAUNA

Evaluation of the trophic types of several Alaskan lakes by assessment of the benthic fauna

Jacqueline D. LaPerriere

Jacqueline D. LaPerriere
Instructor of Water Resources

*The work upon which this report is based was supported in part by funds (A-046-ALAS) provided by the United States Department of the Interior, Office of Water Research and Technology, as authorized under the Water Resources Act of 1964, as amended.*

Institute of Water Resources
University of Alaska
Fairbanks, Alaska, 99701

Report No. IWR-63

March, 1975

## DEDICATION

This report is dedicated to the memory of Eugene W. Surber in recognition of his invaluable contributions to the field of stream ecology.

## ACKNOWLEDGEMENTS

Sincere thanks are extended to those who assisted in this project. The loan of samples and limnological data from Memory and Johnson Lakes by the Palmer Office of the Alaska Department of Fish and Game and of data and maps for Big Lake by the Commercial Fish divisions of ADF&G, Anchorage, are gratefully acknowledged. Special thanks are due all those who aided in sampling: Carl Kalb, Lawrence Casper, Paul Larson, Margaret Hayes, Frederick and Therese Payne, Donald Woodruff, and Arthur LaPerriere. In addition to assisting with sampling, Wolfgang Hebel was helpful in sorting the samples and Martha Kandelin is acknowledged for her invaluable help in rearing the adult chironomids. Judith Henshaw drafted the figures and Mayo Murray edited this report.

The identification of the adult chironomids and verification of selected larval chironomid identifications by Dr. Ole Saether of the Freshwater Institute, Environment Canada, are gratefully acknowledged. The work being done on cytology of the new species of *Chironomus* by Drs. James E. and Mary F. Sublette of the University of New Mexico is also gratefully acknowledged.

The amphipod identification and verification by Dr. John R. Holsinger of Old Dominion University and the oligochaete identifications by Dr. Clarence J. Goodnight of Western Michigan University are deeply appreciated.

TABLE OF CONTENTS

## LIST OF FIGURES

LIST OF TABLES

# INTRODUCTION

Public Law 92-500 (1972) which amends the Federal Water Polluton Control Act contains Section No. 314 entitled *Clean Lakes* which gives each state a mandate to ". . . prepare or establish . . . an identification and classification according to eutrophic condition of all publicly owned fresh water lakes in such state . . . ." This mandate presents an awesome task to the State of Alaska which contains millions of lakes which must be evaluated according to the interpretation of this law.

It was the intent of this project to examine the application of a biological index of eutrophy to several Alaskan lakes by comparing benthic macroinvertebrate faunal distribution to selected chemical and physical indices of trophic state. The investigator chose to consider "indicator organisms" as the focus of the study and found this concept to be interestingly difficult to apply.

Eminent European scientists have long held that the chironomid fauna is indicative of the trophic state of lakes (Brundin, 1949). These organisms soon became the main focus of this study encouraged by the fact that Dr. Ole A. Saether of Environment Canada is conducting in North America the types of studies done by Brundin and Thienemann in Europe. Other scientists have attempted the organization of North American chironomid ecology into meaningful order but because of the lack of extensive taxonomical expertise the studies have been inconclusive or confined to small geographical areas (Curry, 1962). Chironomids are ideally suited to this type of analysis because, as Deevey (1941) pointed out, they are as a group "highly eurytopic."

Since identification to the species is necessary for trophic assessment, this project was extended by the funding agency in order to permit the rearing of as many as possible of the chironomids of Harding Lake to adults of which the male specific characteristics are quite well known.

The results of this study and one to which it is closely connected, "The Nutrient Chemistry of a Large, Deep Lake in Subarctic Alaska" funded by EPA, have resulted in questioning by this investigator and some colleagues whether the concept of eutrophication is applicable to northern lakes (LaPerriere, Casper, and Payne, 1974).

## METHODS

The 1973 samples which were taken by the investigator at Harding, Big, South Rolly, and Milo 1 Lakes were all treated in the following manner. Sampling was accomplished with a standard 15.24 cm square Ekman dredge. Each sample was immediately washed free of sediments in a #30 mesh screen-bottomed bucket, and the remaining contents were washed into a one-quart jar. Alcohol was added to bring the concentration to approximately 25 percent by volume and the samples were returned to the laboratory where they were refrigerated at 5°C until the organisms were picked.

Picking was accomplished on the entire sample by diluting subsamples in white enamel pans and separating the organisms from the debris with forceps. The organisms were separated to order and stored in 90 percent ethanol until identified.

The samples contributed by ADF&G at Palmer from Memory and Johnson Lakes were taken with a Petite Ponar dredge and screened with #10 and #20 mesh screens. The samples were picked by station and all organisms from each sample were preserved together in formalin. Upon receipt of these samples, the organisms were separated to order for each station and preserved in 90 percent ethanol until identified.

Chironomid larvae from the 1973 samples were prepared for identification by preparing head capsule mounts on glass slides. Each chironomid so prepared was heated in 5 percent KOH for fifteen minutes (or overnight in cold KOH) and rinsed in distilled water, then the head was dissected onto a glass slide and covered with a water-miscible mounting medium. After checking that the head was in position with the teeth uppermost, a cover slip and label were affixed. The body was left on the slide if it were sufficiently small and flattened.

In the summer of 1974, attempts were made to rear chironomid larvae to adults to allow identification to species. The rearing effort was made only at Harding Lake where the Institute of Water Resources at the University of Alaska is conducting a three-year study funded by the USEPA entitled "The Nutrient Chemistry of a Large, Deep Lake in Subarctic Alaska."

The samples for this effort were taken with a standard Ponar dredge and treated as above except that ethanol was not added to the quart jars. Picking was accomplished almost immediately at the field laboratory located at the lake. Each chironomid larva or pupa was placed in a separate 10 ml vial with clean lake water and the vial was plugged with cotton.

Daily checks were conducted on all vials so that the adults and associated ecdyses could be preserved. As soon as an adult was observed in a vial, the vial was placed in an ethyl acetate killing jar, then removed, and 90 percent ethanol added and a screw cap affixed. Mounting of the dissected adults and associated ecdyses was conducted by Margaret P. McLean of the Freshwater Institute of Environment Canada and these were identified by Dr. Ole A. Saether of that institute.

Temperature and oxygen values were taken with calibrated probes with the exception of the oxygen values for Memory and Johnson Lakes samples which were analyzed by the Winkler method. Other chemical and physical parameters were measured by various methods. Details concerning these methods are not given as the cited values usually represent only one sample.

## Descriptions of Study Areas

Harding (Salchaket) Lake (64°25'N, 146°50'W) is a relatively large and deep lake located 73 kilometers southeast of Fairbanks, Alaska. It is one of a group of lakes formed by aggradation of the Tanana River closing off nearly parallel valleys, but it is deeper than the others perhaps due to tectonic activity (Blackwell, 1956).

It is a closed-basin lake with no visible outlet, lying at an elevation of 217 meters in an area characterized by a continental subarctic climate. The lake is roughly circular with an area of 988 hectares, a mean and maximum depth of 16m and 43m, respectively, and volume of $1.50 \times 10^8$ cubic meters (Figure 1). The drainage basin of the lake covers slightly more than 2000 hectares giving an extremely low potential watershed input. It should also be noted that in this area the mean annual precipitation is only 30.5 centimeters, with a mean annual snowfall of 127 centimeters, which represents about one third the annual volume. Of the snowpack, an estimated 20-30% is measurable as runoff, the difference being intercepted or evaporated (Guymon, 1973).

The temperature regime of the area may be characterized as extreme with a mean minimum January temperature of -27°C, with an extreme low of -53°C, a mean maximum July temperature of 22°C, extreme high of 32°C, and a mean annual temperature of -5°C (Johnson and Hartman, 1971).

Winters are characteristically clear with little wind. Snowfall is generally concentrated in the period after freeze-up (Watson *et al.*, 1971), diminishing with the onset of winter conditions.

The calculated heat budget of the lake is 8,000 cal/cm$^2$ for the summer and 10,300 cal/cm$^2$ for the winter. The winter budget reflects the large heat requirement for the melting of the ice. Breakup at the lake generally occurs in late May, with reports of ice cover rarely extending into June.

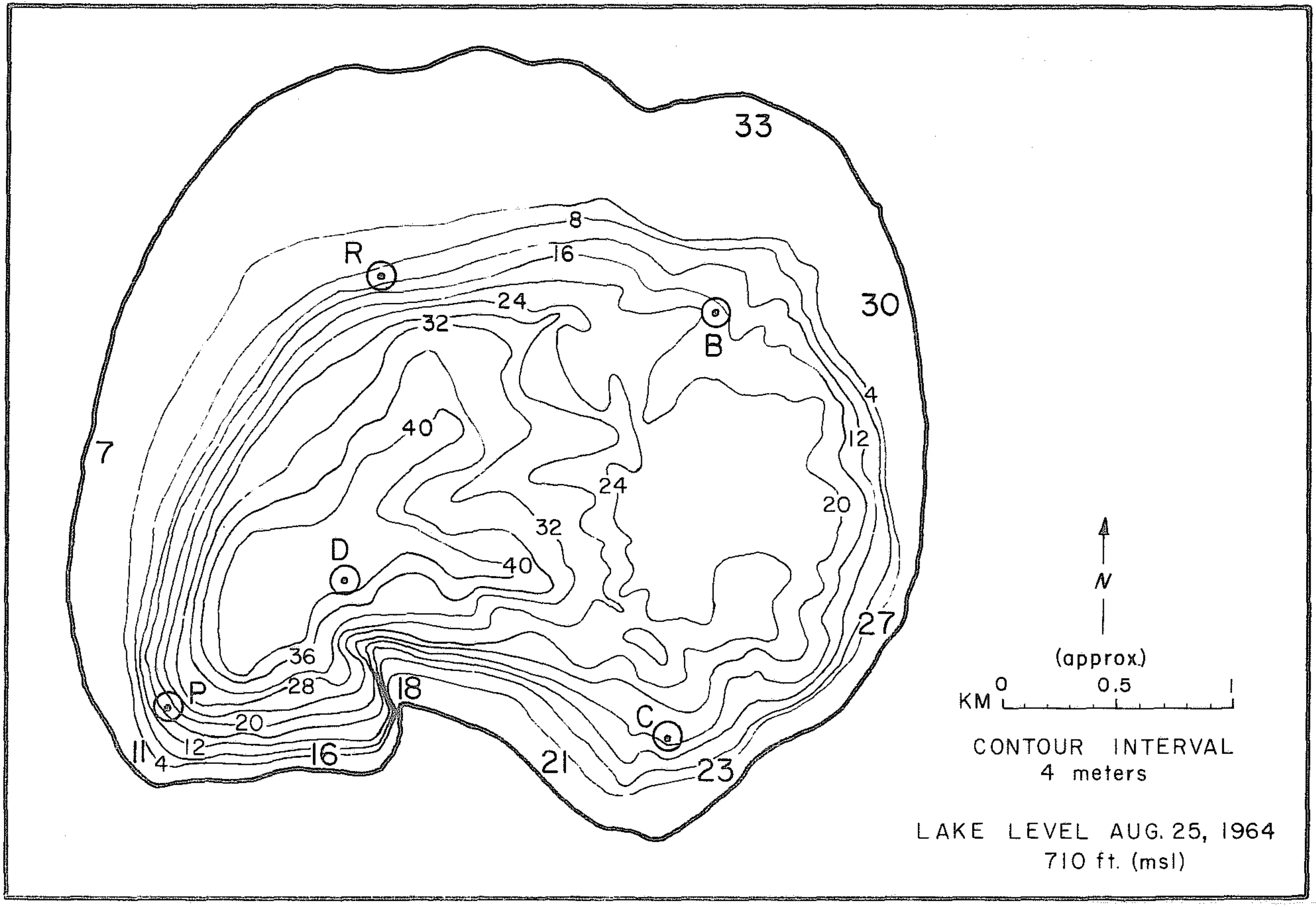



*Figure 1: Morphometric map of Harding Lake, Alaska. Station locations are indicated. (after Blackwell)*

The oxygen profile of the lake follows a classical orthogradient (Figure 2). Sediments collected in the deep trough exhibit low dissolved oxygen, but the effect does not significantly deplete the large hypolimnetic oxygen reserves. Oxygen production and utilization processes both appear to be occurring at low rates during the annual cycles.

Alkalinity values range around 30 mg/l and conductivity is in the 40-50 μmho/cm range, with little apparent variability in the vertical profiles. Some production and respiration is evident in pH profile suppression or elevation, with minor deviation from approximate neutrality.

The nutrient budget for the lake shows multiple deficiencies in those elements. Available nitrogen as nitrate and nitrite is rapidly assimilated after breakup and remains depleted (below 20 μg/l) until autumnal plant senescence. Ammonia likewise shows depletion in the water column except for apparent surface sorption from the atmosphere. Summer levels of orthophosphates are about 2 μg/l, and total organic carbon about 5 mg/l.

The nutrient concentrations of Harding Lake are in the same range or lower than those reported for Lake Tahoe (Lake Tahoe Area Council, 1971), generally considered a highly oligotrophic lake. Other examples might be cited from the literature, but the oligotrophic nature of the lake in terms of nutrient availability is obvious.

The other five lakes that this study concerns are all located within forty miles of Anchorage, Alaska. The temperature regime of this area is somewhat milder than that of the Harding Lake area due to the tempering influence of the ocean. While the climate is not quite maritime, it is also not continental; it is transitional between the two. The mean minimum January temperature is -7°C; the mean maximum July temperature is 20°C; and the mean annual temperature is -1°C.

Johnson Lake (61°34'N, 149°14'W) (Figure 3) and Memory Lake (61°37'45"N, 149°25'15"W) (Figure 4) are located in the Matanuska Valley where the soil and climate have been found very suitable for agriculture.

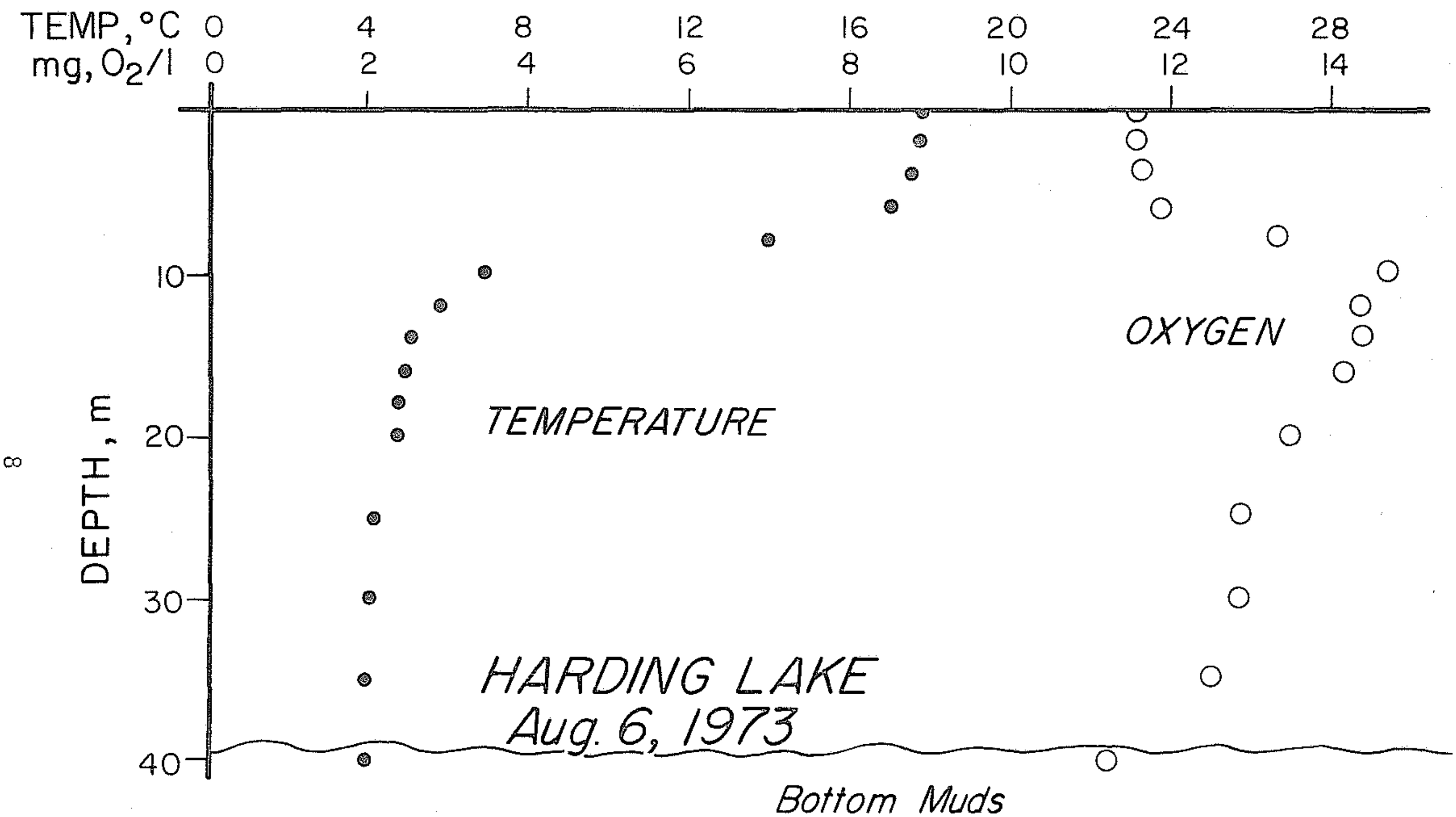



Figure 2: Harding Lake temperature and oxygen profiles during summer stratification.

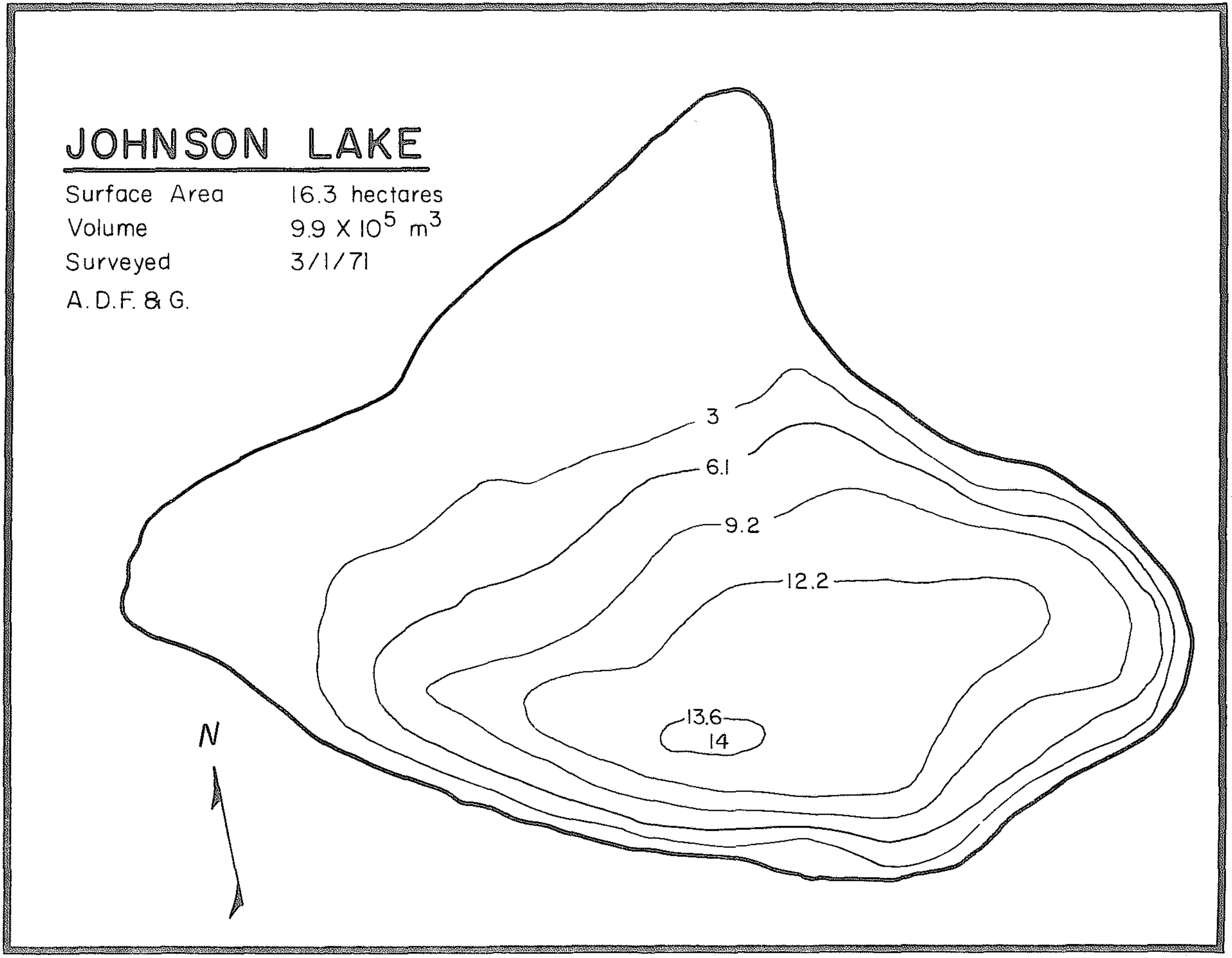



Figure 3: Morphometric map of Johnson Lake, Alaska.

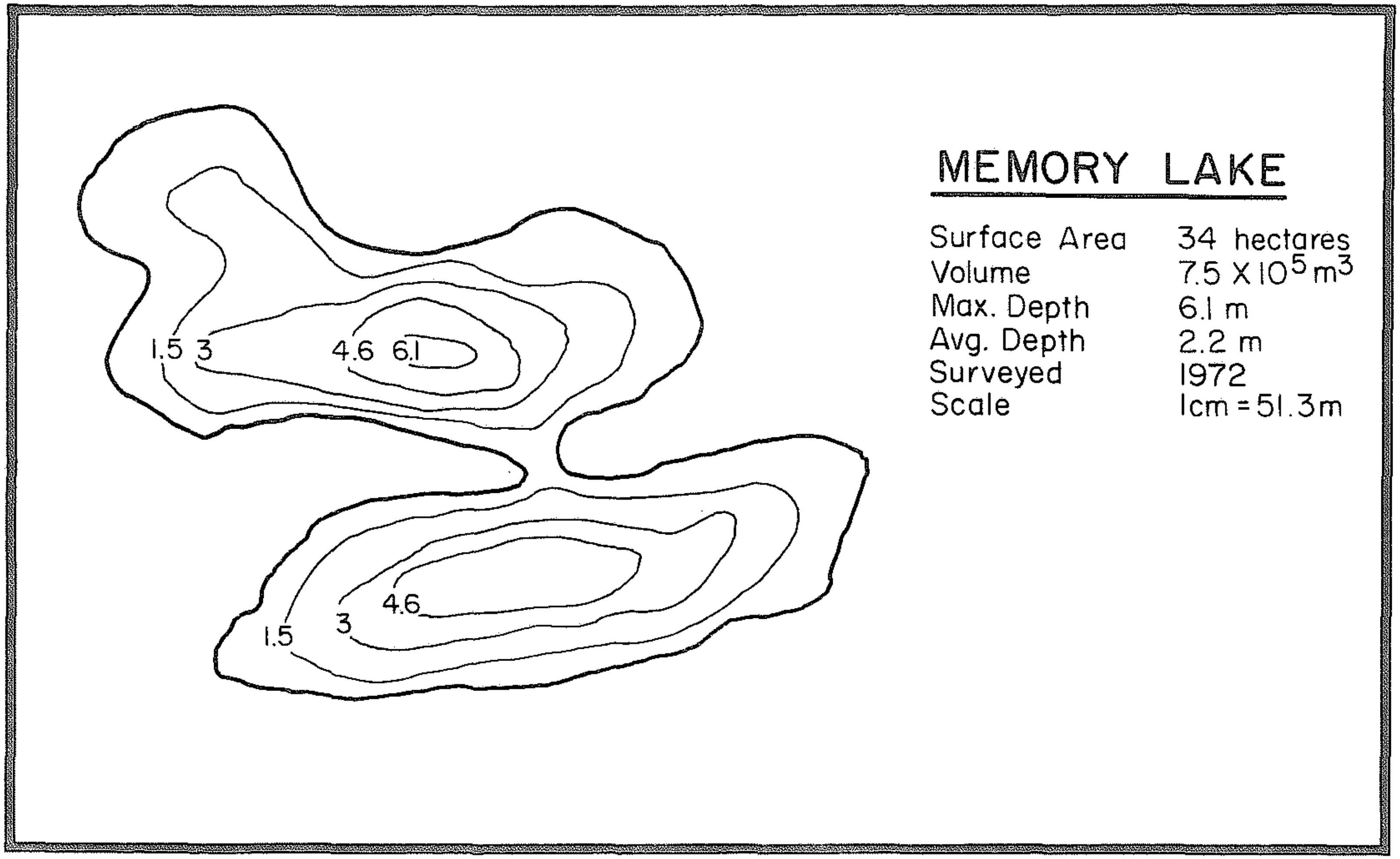
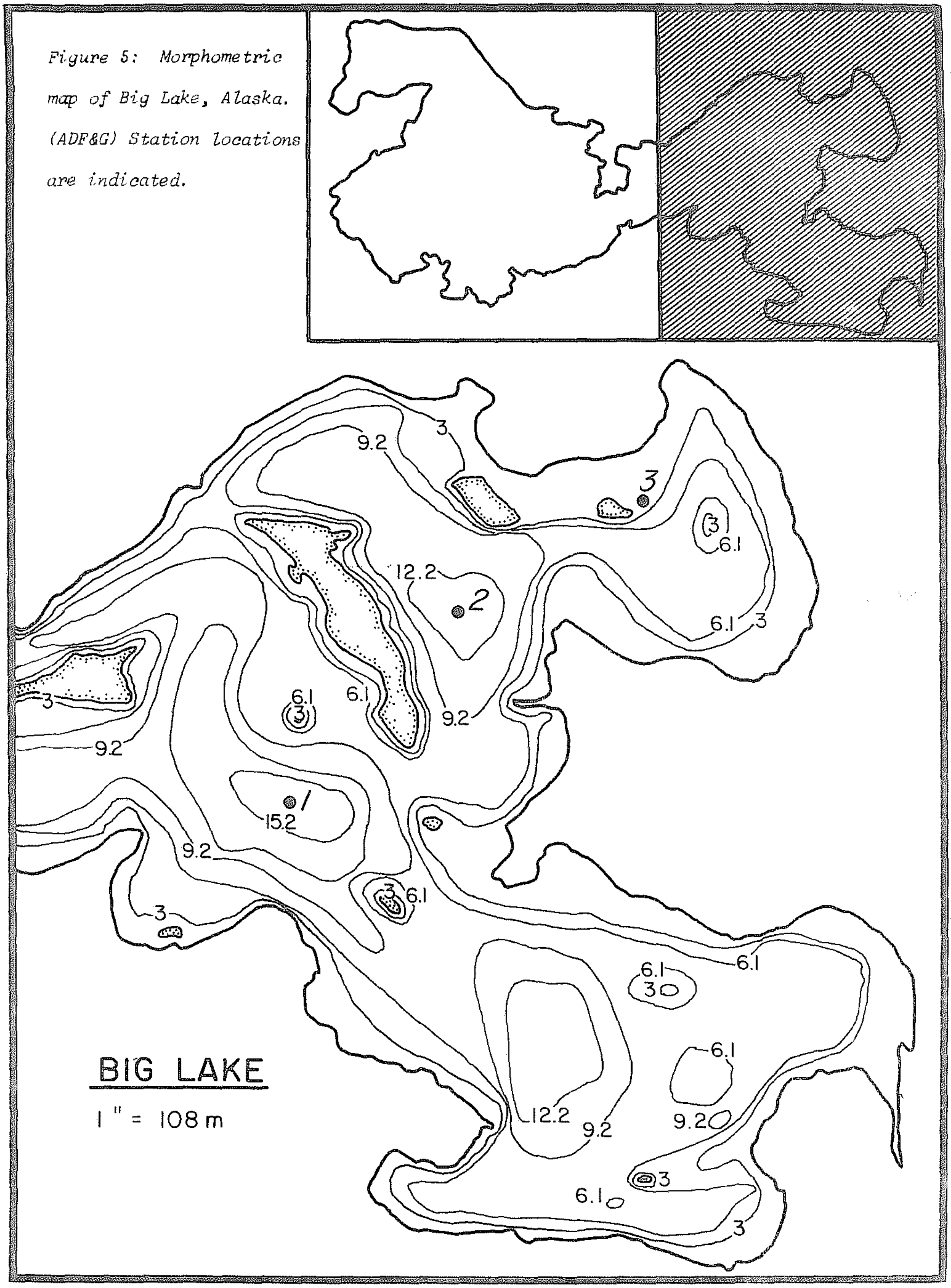



Figure 4. Morphometric map of Memory Lake, Alaska (ADF&G).

Figure 5: Morphometric map of Big Lake, Alaska. (ADF&G) Station locations are indicated.



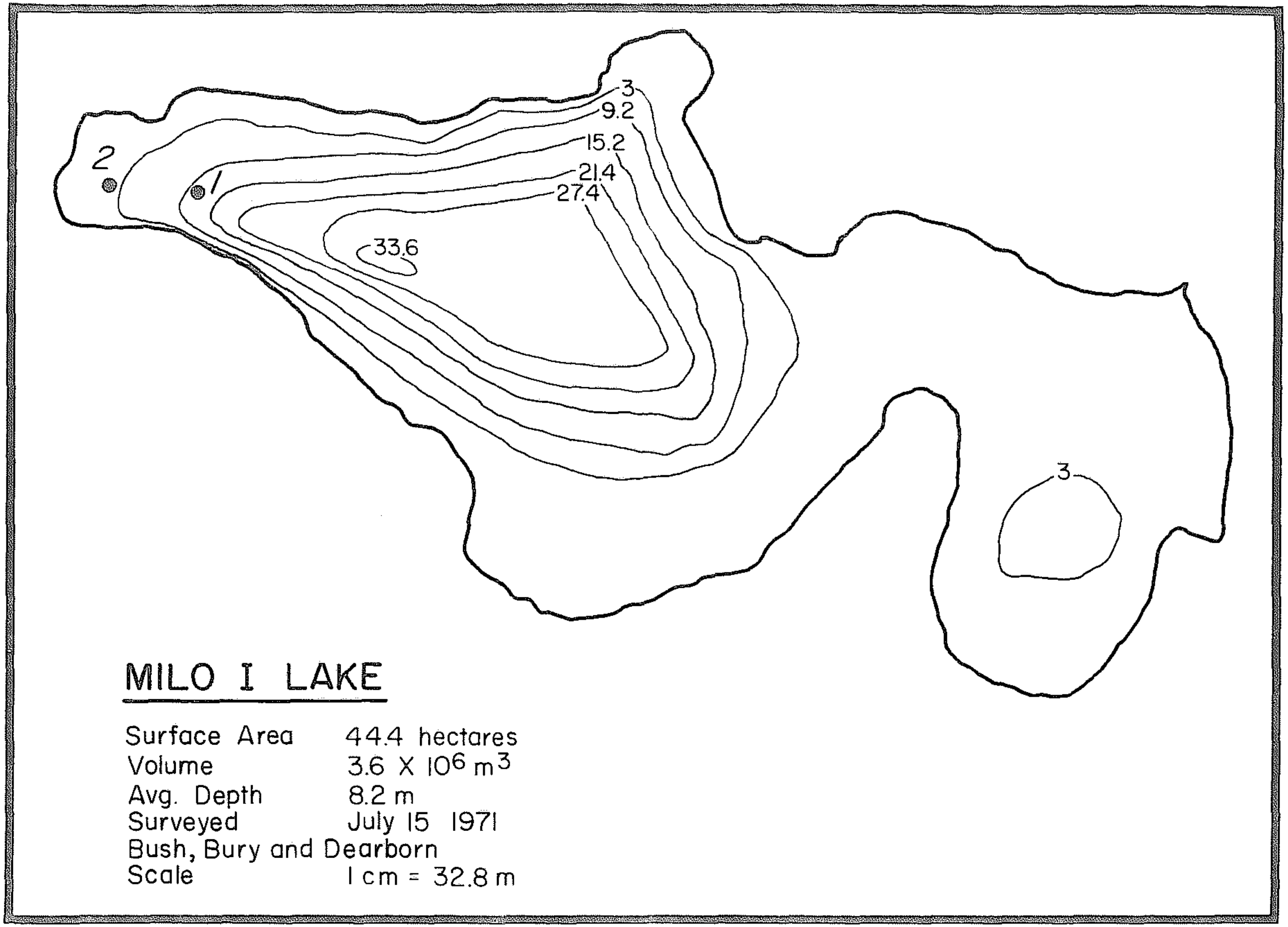



*Figure 6: Morphometric map of Milo I Lake, Alaska. (ADF&G) Station locations are indicated.*

Big Lake (61°32'N, 149°54'W) (Figure 5) is located along the newly completed highway between Fairbanks and Anchorage and it is heavily used for recreation by Anchorage residents. Milo I Lake (61°40'N, 150°6'W) (Figure 6) and South Rolly Lake (61°40'30"N, 150°8'W) are located within the Nancy Lakes Recreational Area and have only recently (1973) become accessible by road.

Four of these lakes are closed basins but may have a larger potential nutrient input than Harding Lake due to the higher amount of annual precipitation (66 cm).

# RESULTS

Selected morphometric, chemical, and physical parameters for the six lakes of this study are presented in Table 1. As pointed out in Methods, most of the results presented are for a single sample or a small set of samples. Only the data for Harding Lake has been taken from an annual sampling program.

Except for Big Lake, for which there is inadequate data, and Memory Lake, which is shallow, these lakes appear to be oligotrophic by most standards. In other words, nutrient availability is low.

If oxygen data is considered (Table 2 and Figures 2 and 7 through 9) the interpretation problems discussed by Hutchinson (1957) in his *Treatise on Limnology* are encountered, but none of the oxygen curves for the three lakes over 20 m deep can be said to be clinograde, which indicates low productivity in all three. Of course, oxygen data for the shallower lakes cannot be at all easily interpreted because of the relatively more important influence of winds and the like for which the data is not at hand. It is interesting to note the under-ice depletion of oxygen at Memory and Johnson Lakes (Table 2). It is especially interesting to note that, while the ice is still on these lakes in April, oxygen is mysteriously being replenished. This is not quite such a paradox when one considers the ice and light conditions. At that time of year the ice becomes transparent to light due to the melting of the snow cover and the increased porosity of the ice. These lakes are also experiencing over 14 hours of sunlight at that time of year. Fish and Game personnel from the Palmer Office have observed visible algal blooms at this type of shallow lake under the spring ice.

Identification and enumeration data concerning the benthic macroinvertebrates is contained in Tables 3 through 9. Sampling locations are marked on the appropriate morphometric maps for those cases for which this was possible. Chironomids are named according to the classification system of Hamilton *et al.*

TABLE 1. SELECTED PARAMETERS OF SIX ALASKAN LAKES

| | Memory Lake | Johnson Lake | South Rolly Lake | Milo I Lake | Big Lake | Harding Lake |
|---|---|---|---|---|---|---|
| Surface area (hectares) | 34.0 | 16.3 | 45.8 | 44.4 | 1214.2 | 988 |
| Maximum depth (m) | 6.1 | 14.0 | 18.0 | 33.6 | 27 | 43 |
| Mean depth (m) | 2.2 | - | - | 8.2 | 9.1 | 16 |
| Inlets ($m^3$/sec) | none | none | small/or none | 0.02 | 0.18 | Fractional not gauged |
| outlets (cms) | none | none | swamp | intermittent | 1.20 | none |
| conductivity (μmho/cm) | 41 | 148 | 31 | 19 | - | 40-50 |
| Total P (mg/l) | 0.00 | 0.01 | 0.00 | - | - | - |
| $NH_4$-N (mg/l) | 0.04 | 0.007 | 0.03 | 0.17 | - | 0.002-0.020 |
| $NO_2/NO_3$ - N (mg/l) | 0.00 | - | 0.00 | 0.02 | - | 0.02-0.26 |
| Total Keldahl N (mg/l) | 0.50 | 0.46 | 0.37 | 0.92 | - | - |
| Color (PE units) | - | - | - | 15 | - | 30 |
| Total dissolved solids (mg/l) | - | - | - | 13 | 70-110 | 50-100 |
| Alkalinity (mg/l as $CaCO_3$) | 21 | 71 | 19 | - | - | 30 |
| Shoreland Development | few houses | none | camping site | none | intense | fairly intense |

TABLE 2. DISSOLVED OXYGEN MEASUREMENTS FOR MEMORY AND JOHNSON LAKES NEAR PALMER, ALASKA (A.D.F.& G.)

MEMORY LAKE DISSOLVED OXYGEN (mg/l)

| Depth (m) | 5/31 | 6/20 | 7/20 | 8/23 | 9/19 | 11/23 | 12/17 | 1/22 | 2/26 | 3/22 | 4/10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.5 | 10.8 (102)* | 10.0 (100) | 8.6 (92) | 9.6 (91) | 10.4 (94) | 13.3 (100) | 10.9 | 9.6 | 9.3 | 7.2 | 8.1 (61) |
| 3.1 | 11.1 (104) | 10.0 (100) | 9.0 (105) | 9.9 (99) | 10.5 (95) | 11.5 (88) | 10.0 | 9.0 | 7.6 | 7.2 | 8.5 (64) |
| 4.6 | 11.4 (104) | 9.1 (88) | 8.3 (89) | 9.4 (93) | 10.8 (97) | 8.4 (63) | 7.2 | 8.0 | 5.1 | 5.9 | 8.1 (61) |
| Ice (m) | - | - | - | - | - | .31 | - | .84 | .97 | .97 | .79 |

JOHNSON LAKE DISSOLVED OXYGEN (mg/l)

| Depth (m) | 5/16 | 6/20 | 7/20 | 8/20 | 9/17 | 11/21 | 12/17 | 1/16 | 2/26 | 3/19 | 4/10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.5 | 12.3 (88) | 10.6 (108) | 9.6 (102) | 10.0 (103) | 10.1 (90) | 10.0 (74) | 9.0 | 8.3 | 7.3 | 7.2 | 7.3 (54) |
| 3.1 | 12.3 (107) | 10.5 (107) | 9.6 (102) | 9.9 (100) | 10.4 (92) | 9.2 (69) | 9.0 | 7.5 | 6.6 | 6.4 | 7.9 (60) |
| 6.1 | 12.3 (100) | 11.9 (107) | 12.5 (121) | 9.9 (101) | 9.8 (87) | 9.4 (71) | 8.7 | 6.9 | 6.2 | 7.4 | 7.2 (54) |
| 9.1 | 9.1 (73) | 9.9 (80) | 10.2 (86) | 10.6 (92) | 9.2 (81) | 8.3 (70) | 5.9 | 4.1 | 5.5 | 4.0 | 4.2 (32) |
| 12.2 | 5.8 (47) | 1.8 (14) | 5.1 (40) | 1.7 (6) | 0.8 (6) | 4.8 (36) | 0.9 | - | 1.0 | 0.7 | 0.6 ( 4) |
| Ice (m) | - | - | - | - | - | .31 | - | - | .91 | .99 | .81 |

*Numbers in parentheses indicate percent saturation.

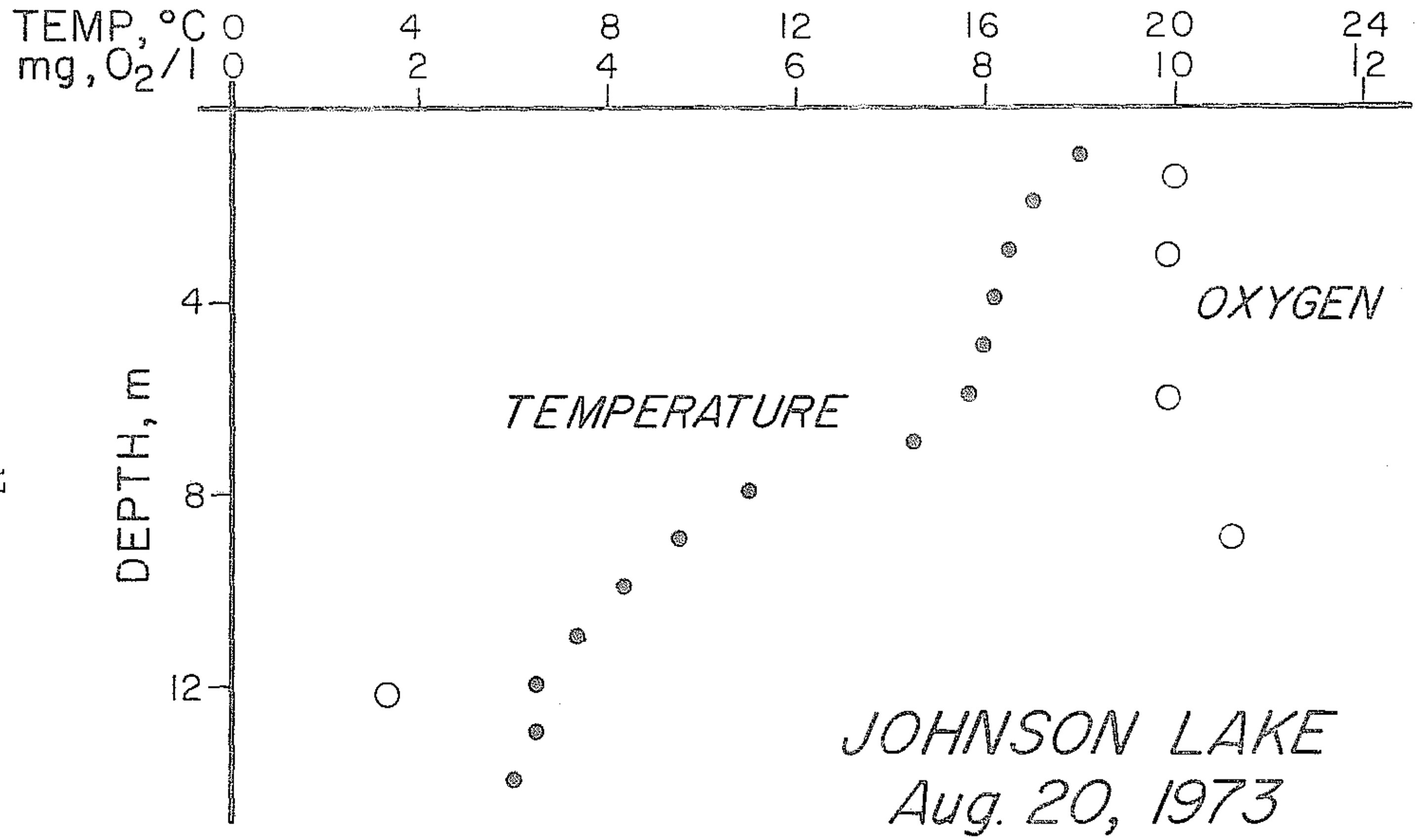



Figure 7: Temperature and oxygen profiles during summer stratification - Johnson Lake.

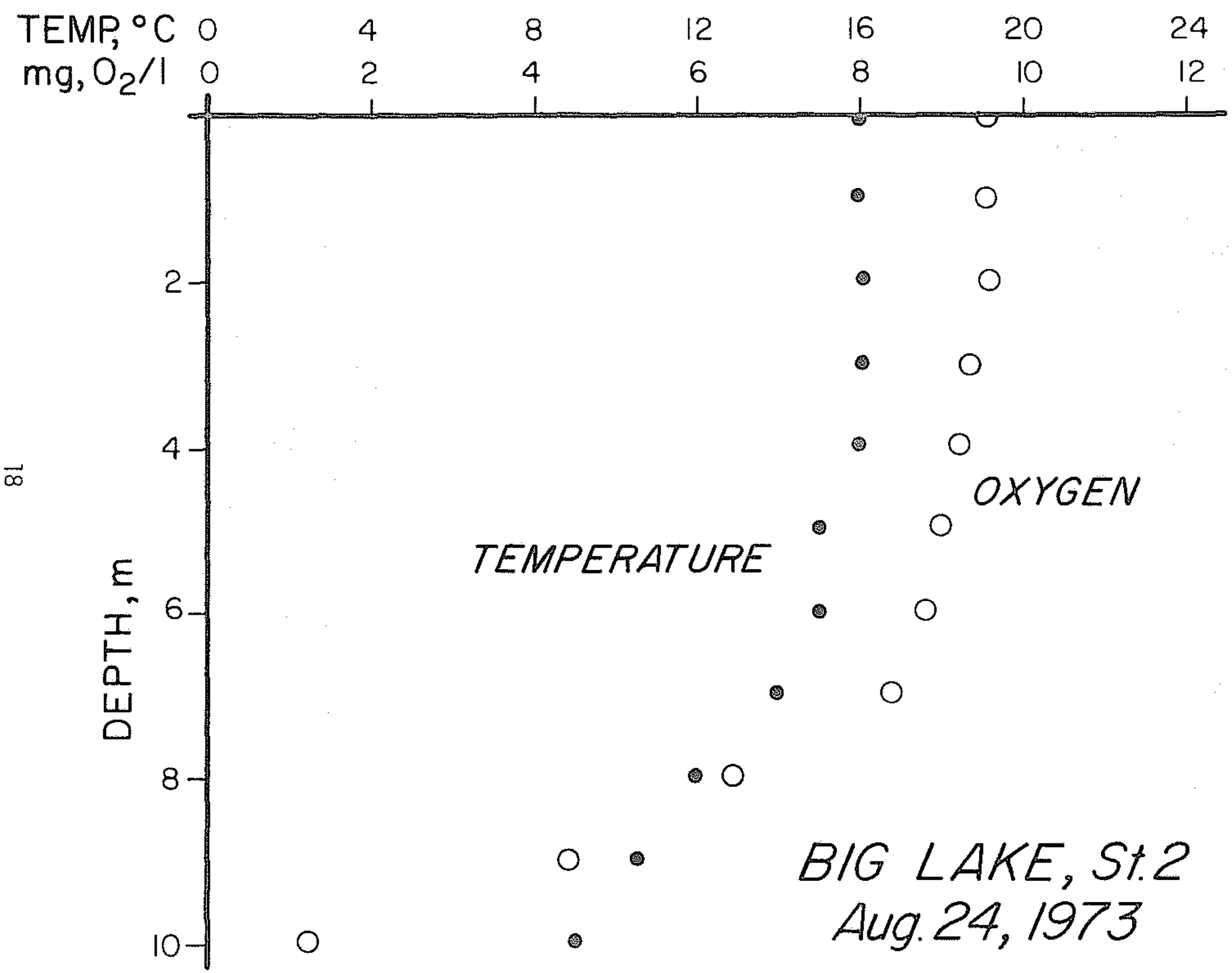



Figure 8: Temperature and oxygen profiles during summer stratification - Big Lake.

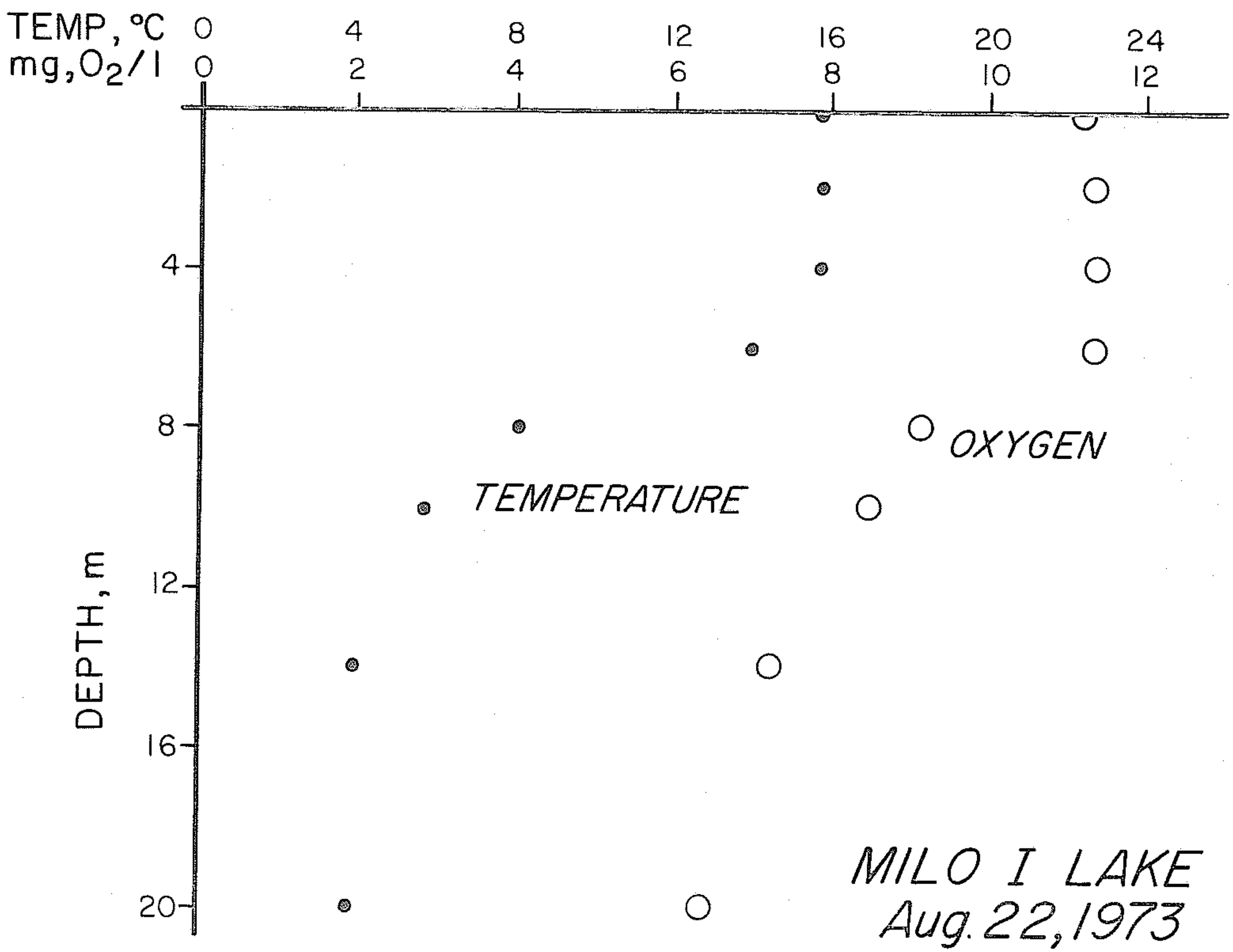



Figure 9: Temperature and oxygen profiles during summer stratification - Milo I Lake.

TABLE 3:

HARDING LAKE - DEEPWATER STATIONS

BENTHIC MACROINVERTEBRATES

Sampled July 24, 1973

| STATION | DEPTH | ORGANISM GROUP | IDENTIFICATION | NUMBER * |
|---|---|---|---|---|
| P Sample I | 20 m | chironomids (c.) | *Phaenopsectra* sp. | 4 |
| | | clams (cl.) | *Pisidium* sp. | 4 |
| | | worms (w.) | *Peloscolex* sp. | 6 |
| P Sample II | 20 m | c. | *Phaenopsectra* sp. | 5 |
| | | w. | *Peloscolex kurankovi* | 4 |
| P Sample III | 20 m | c. | *Phaenopsectra* sp. | 5 |
| | | | *Phaenopsectra* sp. | 1 ecdysis |
| | | w. | *Peloscolex kurankovi* | 1 |
| D Sample I | 42 m | cl. | *Pisidium* sp. | 3 |
| | | w. | *Peloscolex* sp.* | 1 |
| D Sample II | 42 m | c. | *Phaenopsectra* sp. | 1 |
| | | cl. | *Pisidium* sp. | 1 |
| D Sample III | 42 m | c. | *Phaenopsectra* sp. | 1 ecdysis |
| | | w. | *Peloscolex* sp. | 2 |
| | | | unidentified tubificid | 1 |
| C Sample I | 18 m | w. | *Peloscolex* sp. | 1 |
| | | | unidentified tubificid | 1 |
| C Sample II | 18 m | c. | *Monodiamesa bathyphilia* | 1 ecdysis |
| | | | *Procladius* sp. | 2 |
| | | | *Protanypus* sp. | 1 |
| | | cl. | *Pisidium* sp. | 5 |

*complete specimen except where noted

**incomplete specimen

TABLE 3 (cont.)

| STATION | DEPTH | GROUP | IDENTIFICATION | NUMBER |
|---|---|---|---|---|
| | | | ORGANISM | |
| C Sample III | 18 m | cl. | *Pisidium* sp. | 3 |
| B Sample I | 16 m | c. | *Chironomus* sp. (pupa) | 1 |
| | | | *Monodiamesa bathyphilia* | 3 ecdyses |
| | | | *Phaenopsectra* sp. | 1 |
| | | | *Procladius* sp. | 3 |
| | | | *Procladius* sp. | 2 ecdyses |
| | | | *Protanypus* sp. | 2 |
| | | | *Protanypus* sp. | 3 ecdyses |
| | | | *Stictochironomus rosenschöldi* | 1 ecdysis |
| | | w. | *Peloscolex* sp. | 1 |
| B Sample II | 16 m | c. | *Protanypus* | 2 |
| B Sample III | 16 m | c. | *Monodiamesa bathyphilia* | 1 ecdysis |
| | | | *Protanypus* sp. | 2 |
| | | | | 6 ecdyses |
| | | cl. | *Pisidium* sp. | 8 |
| | | snails (s.) | *Lemnea* sp. | 1 |
| | | w. | unidentified tubificid | 1 |
| R Sample I | 11 m | c. | *Monodiamesa bathyphilia* | 1 |
| | | | | 6 ecdyses |
| | | | *Procladius* sp. | 1 |
| | | | *Protanypus* sp. | 2 ecdyses |
| | | | *Phaenopsectra* sp. | 1 ecdysis |
| | | s. | *Lymnea* sp. | 9 |
| | | w. | *Peloscolex* sp. | 1 |
| R Sample II | 11 m | c. | *Procladius* sp. | 3 |
| | | | *Protanypus* sp. | 1 |
| | | cl. | *Pisidium* sp. | 2 |
| | | copepod (cd.) | unidentified calanoid | 4 |
| | | mites (m.) | unidentified | 1 |
| | | s. | *Lymnea* sp. | 5 |
| | | w. | *Peloscolex* sp. | 1 |

TABLE 3. (cont.)

| STATION | DEPTH | ORGANISM GROUP | IDENTIFICATION | NUMBER |
|---|---|---|---|---|
| R Sample III | 11 m | c. | *Phaenopsectra* sp. | 1 |
| | | cl. | *Pisidium* sp. | 1 |
| | | w. | *Peloscolex* sp. | 3 |
| | | | unidentified tubificid | 1 |

TABLE 4:

HARDING LAKE - SHALLOW WATER STATIONS

BENTHIC MACROINVERTEBRATES

Sampled August 17, 1973

| STATION | DEPTH | ORGANISM GROUP | IDENTIFICATION | NUMBER |
|---|---|---|---|---|
| 7 | 0.75 m | amphipods (a.) | *Hyallea azteca* | 1 |
| | | ceratopogonids (ce.) | *Palpomyia* sp. | 7 |
| | | | unidentified adult | 1 |
| | | clams (cl.) | *Pisidium* sp. | 15 |
| | | empidids (e.) | unidentified larva | 1 |
| | | leeches (l.) | *Dina* sp. | 1 |
| | | nematomorphs (n.) | unidentified | 1 |
| | | snails (s.) | *Lymnea* | 2 |
| | | | *Gyrallus* sp. (type 2) | 1 |
| | | trichopterans (t.) | unidentified Beraeidae | 1 |
| | | | unidentified Limnephilidae | 1 |
| | | | *Setodes* sp. | 1 |
| 11 (Sample 1) | 1.0 m | a. | *Hyalella azteca* | 22 |
| | | c. | *Clinotanypus* sp. | 1 |
| | | cl. | *Pisidium* sp. | 16 |
| | | l. | *Dina* sp. | 1 |
| | | s. | *Lymnea* sp. | 1 |
| | | | *Gyrallus* (type 1) | 3 |
| | | | *Gyrallus* (type 2) | 2 |
| 11 (Sample 2) | 1.0 m | a. | *Hyalella azteca* | 15 |
| | | nematode (ne.) | unidentified | 1 |
| | | s. | *Gyrallus* sp. | 1 |
| | | worms (w.) | *Peloscolex* sp. | 13 |
| 16 | 6 m | c. | *Monodiamesa bathyphilia* | 1 ecdysis |
| | | | *Procladius* sp. | 3 |
| | | | *Stempellina* sp. | 1 |
| | | cl. | *Pisidium* sp. | 5 |
| | | t. | *Setodes* sp. | 1 |
| | | w. | *Peloscolex* sp. | 15 |
| | | | unidentified tubificid | 3 |
| 18 | 1 m | a. | *Hyalella azteca* | 7 |
| | | c. | *Demichryptochironomus* sp. | 1 |
| | | | *Tanytarsus* sp. | 1 |

TABLE 4 (cont.)

| STATION | DEPTH | ORGANISM GROUP | ORGANISM IDENTIFICATION | ORGANISM NUMBER |
|---|---|---|---|---|
| | | ce. | unidentified | 1 |
| | | cl. | *Pisidium* sp. | 15 |
| | | copepods (cd. | unidentified | 1 |
| | | tabanids (ta.) | *Chryspos* sp. | 1 |
| | | w. | *Peloscolex* sp. | 5 |
| | | | unidentified tubificid | 10 |
| 21 | 1.5 m (this is a composite of two dredge samples) | | | |
| | | a. | *Hyalella azteca* | 53 |
| | | ce. | *Leptoconops* (adult) | 1 |
| | | | *Palpomyia* sp. | 2s |
| | | | *Dicrotendipes* sp. | 8 |
| | | | *Microtendipes* sp. | 1 |
| | | | *Potthastia* sp. | 1 |
| | | | *Procladius* sp. | 1 |
| | | | *Parachironomus* sp. | 2 |
| | | | *Stimpellina* sp. | 28 |
| | | | *Tanytarsus* sp. | 1 |
| | | cl. | *Pisidium* sp. | 36 |
| | | l. | *Dina dubia* | 1 |
| | | m. | unidentified | 1 |
| | | s. | *Gyrallus* (type 1) | 2 |
| | | | *Gyrallus* (type 2) | 4 |
| | | | *Lymnea* sp. | 1 |
| | | t. | *Leptocella* sp. | 2 |
| | | | unidentified pupa | 1 |
| | | w. | *Peloscolex* sp. | 15 |
| | | | unidentified tubificids | 20 |
| 23 | 1.3 m | a. | *Hyalella azteca* | 49 |
| | | c. | *Harnischia* sp. | 1 |
| | | cl. | *Pisidium* sp. | 5 |
| | | l. | *Dina* sp. | 4 |
| | | mayfly (ma.)* | *Paracloeodes* sp. | 2 |
| | | m. | unidentified | 1 |
| | | t. | unidentified Beraeidae | 1 |
| | | w. | *Peloscolex* sp. | 32 |
| | | | unidentified Lumbriculidae incomplete | 6 |
| | | | unidentified tubificids | 6 |

*Many more mayflies and stoneflies would have been captured had sampling been accomplished earlier in the year.

TABLE 4. (cont.)

| STATION | DEPTH | ORGANISM GROUP | ORGANISM IDENTIFICATION | ORGANISM NUMBER |
|---|---|---|---|---|
| 25 | 1 m | a. | *Hyalella azteca* | 18 |
| | | s. | *Lymnea* sp. | 1 |
| | | | *Gyrallus* (type 1) | 1 |
| | | | *Gyrallus* (type 2) | 3 |
| | | t. | unidentified Beraeidae | 1 |
| | | | *Trianodes* sp. | 2 |
| | | w. | unidentified Lumbriculidae | 2 |
| 27 | 1 m | a. | *Hyalella azteca* | 12 |
| | | c. | *Ablabesmyia* | 1 |
| | | m. | *Paracloeodes* | 2 |
| | | n. | unidentified | 1 |
| | | s. | *Gyrallus* (type 2) | 3 |
| | | | *Lymnea* sp. | 1 |
| | | t. | unidentified Beraeidae | 1 |
| | | w. | *Peloscolex* sp. | 1 |
| 30 | 0.5 m | a. | *Hyalella azteca* | 10 |
| | | ce. | *Palpomyia* sp. | 1 |
| | | c. | *Cryptochironomus digitatus* | 4 |
| | | | *Stictochironomus rosenscholdi* | 6 |
| | | cl. | *Pisidium* sp. | 2 |
| | | ma. | *Paracloeodes* sp. | 2 |
| | | s. | *Physa* sp. | 1 |
| | | | *Gyrallus* (type 1) | 5 |
| | | t. | unidentified Beraeidae | 1 |
| | | | *Trianodes* sp. | 1 |
| | | w. | unidentified Lumbriculidae | 1 |
| | | | unidentified tubificid | 2 |
| 35 | 1.3 m | a. | *Hyalella azteca* | 6 |
| | | ce. | *Palpomyia* sp. | 3 |
| | | c. | *Polypedium* sp. | 1 |
| | | | *Stimpellina* sp. | 1 |
| | | cl. | *Pisidium* sp. | 1 |
| | | l. | *Dina* sp. | 1 |
| | | m. | unidentified | 1 |
| | | s. | *Lymnea* | 2 |
| | | | *Gyrallus* (type 2) | 5 |
| | | ta. | *Chrysops* sp. | 1 |
| | | t. | unidentified Beraeidae | 1 |
| | | w. | *Peloscolex* sp. | 7 |
| | | | unidentified tubificid | 4 |

TABLE 5.

MEMORY LAKE

BENTHIC MACROINVERTEBRATES

| DATE | DEPTH | ORGANISM GROUP | IDENTIFICATION | NUMBER |
|---|---|---|---|---|
| 7/20/73 | 1' | amphipods (a.) | *Gammarus lacustris* | 5 |
| | | chironomids (c.) | *Procladius* sp. | 1 |
| | | caddisflies (cd.) | *Oecetis* sp. | 1 |
| | | clams (cl.) | *Pisidium* sp. | 17 |
| | | snails (s.) | *Gyrallus* sp. | 1 |
| | | worms (w.) | *Lumbriculus* sp. | 1 |
| | 5' | a. | *G. lacustris* | 38 |
| | | c. | *Cryptochironomus* sp. | 1 |
| | | | *Dicrotendipes* sp. | 1 |
| | | | *Procladius* sp. | 2 |
| | | cl. | *Pisidium* sp. | 4 |
| | | leeches (l.) | *Glossophonia heteroclita* | 1 |
| | | s. | *Gyrallus* sp. | 1 |
| | 10' | a. | *G. lacustris* | 2 |
| | | c. | *Procladius* sp. | 1 |
| | | cl. | *Pisidium* sp. | 4 |
| | | s. | *Gyrallus* sp. | 1 |
| 8/8/73 | 10' | a. | *G. lacustris* | 6 |
| | 18' | a. | *G. lacustris* | 1 |
| | | cl. | *Pisidium* sp. | 20 |
| | | s. | *Gyrallus* sp. | 2 (e.)* |
| 8/23/73 | 1' | a. | *G. lacustris* | 2 |
| | | cl. | *Pisidium* sp. | 20 |
| | | s. | *Gyrallus* sp. | 1 |
| | | w. | *Lumbriculus* sp. (incomplete) | 1 |
| | 5' | a. | *G. lacustris* | 4 |
| | | c. | *Chironomus* sp. | 2 |
| | | | *Cryptochironomus digitatus* | 2 |
| | | cl. | *Pisidium* sp. | 22 |
| | | mites (m.) | unidentified | 1 |
| | 18' | cl. | *Pisidium* sp. | 2 |

*e. = empty shell

TABLE 5. (cont.)

| DATE | DEPTH | ORGANISM GROUP | ORGANISM IDENTIFICATION | ORGANISM NUMBER |
|---|---|---|---|---|
| 9/7/73 | 1' | a. | *G. lacustris* | 4 |
| | | c. | *Cryptochironomus digitatus* | 4 |
| | | cd. | *Phryganea* sp. | 1 |
| | | cl. | *Pisidium* sp. | 23 |
| | | s. | *Gyrallus* sp. | 1 (e.)* |
| | 5' | a. | *G. lacustris* | 1 |
| | | c. | *Cryptochironomus digitatus* | 1 |
| | | cl. | *Pisidium* sp. | 8 |
| | 18' | c. | *Cryptochironomus digitatus* | 1 |
| | | | unidentified adult (male) | 1 |
| 9/19/73 | 1' | a. | *G. lacustris* | 2 |
| | | c. | *Cryptochironomus digitatus* | 2 |
| | | cl. | *Pisidium* sp. | 5 |
| | 5' | s. | *Gyrallus* sp. | 1 (1 e.) |
| | 10' | a. | *G. lacustris* | 3 |
| | | cl. | *Pisidium* sp. | 11 |
| | | s. | *Gyrallus* sp. | 2 (4 e.) |
| | 18' | bugs (b.) | *Graptocorixa* sp. | 1 |
| | | c. | *Chironomus* sp. | 14 |
| | | cl. | *Pisidium* sp. | 5 |

*e. = empty shell

TABLE 6.

JOHNSON LAKE

BENTHIC MACROINVERTEBRATES

| | | ORGANISM | | |
|---|---|---|---|---|
| DATE | DEPTH | GROUP | IDENTIFICATION | NUMBER |
| 7/20/73 | 1' | amphipods (a.) | *G. lacustris* | 1 |
| | | beetles (bt.) | *Galerucella (nymphaeae?)* | 1 |
| | | caddisflies (cd.) | Limnephilidae unidentified type 1 | 1 |
| | | Chironomids (c.) | *Chironomus* sp. | |
| | | | *Procladius* sp. | 2 |
| | | clams (cl.) | *Pisidium* sp. | 23 |
| | | snails (s.) | *Gyrallus* sp. | 2 |
| | 5' | cd. | Limnephilidae unidentified type 1 | 1 |
| | | cl. | *Pisidium* sp. | 20 |
| | | dragon flies (d.) | *Somatochlora* sp. | 1 |
| | | leeches (l.) | *Glossophonia complanata* | 1 |
| | | s. | *Gyrallus* sp. | 1 (14 e.)* |
| | 10' | c. | *Einfeldia* sp. | 1 |
| | | | *Polypedium* sp. | 1 |
| | | | *Tanytarsus* sp. | 1 |
| | | cl. | *Pisidium* sp. | 19 |
| | | l. | *Helobdella* sp. | 1 |
| | | | *Helobdella stagnalis* | 3 |
| | | s. | *Gyrallus* sp. | 2 (11 e.) |
| | 20' | c. | *Chironomus* sp. | 1 |
| | | | *Cryptochironomus digitatus* | 1 |
| | | | *Polypedium* sp. | 2 |
| | | | *Procladius* sp. | 10 |
| | | | *Tanytarsus* sp. | 3 |
| | 30' | c. | *Chironomus* sp. | 32 |
| | | | *Procladius* sp. | 1 |
| | | | *Tanytarsus* sp. | 2 |
| | | | unidentified pupae | 2 |
| | | w. | *Peloscolex* sp. | 3 |
| 8/8/73 | 1' | a. | *G. lacustris* | 9 |
| | | cl. | *Pisidium* sp. | 31 |
| | | s. | *Gyrallus* sp. | 2 (2 e.) |

*e. = empty shell

TABLE 6. (cont.)

| DATE | DEPTH | ORGANISM GROUP | IDENTIFICATION | NUMBER |
|---|---|---|---|---|
| | 5' | a. | *G. lacustris* | 25 |
| | | c. | *Dicrotendipes* sp. | 1 |
| | | | *Polypedium* sp. | 1 |
| | | | *Procladius* sp. | 1 |
| | | | *Tanytarsus* sp. | 4 |
| | | cd. | Limnephilidae unidentified type 2 | 1 |
| | | cl. | *Pisidium* sp. | 23 |
| | | s. | *Gyrallus* sp. | 17 |
| | | w. | *Ilyodrilus* sp. | 1 |
| 8/8/73 | 10' | a. | *G. lacustris* | 1 |
| | | c. | *Chironomus* sp. | 7 |
| | | | *Cryptochironomus digitatus* | 1 |
| | | | *Tanytarsus* sp. | 8 |
| | | cl. | *Pisidium* sp. | 18 |
| | | s. | *Gyrallus* sp. | 2 (7 e.)* |
| | | w. | Limnephilidae unidentified type 2 | 1 |
| | 20' | c. | *Procladius* sp. | 1 |
| | | | *Tanytarsus* sp. | 1 |
| | | | unidentified pupae | 1 |
| | | cl. | *Pisidium* sp. | 20 |
| | 30' | c. | *Chironomus* sp. | 22 |
| | | | *Phaenopsectra* sp. | 1 |
| | | | unidentified pupae | 1 |
| | 45' | cl. | *Pisidium* sp. | 1 |
| | | s. | *Gyrallus* sp. | 8 (8 e.) |
| 8/20/73 | 1' | a. | *G. lacustris* | 5 |
| | | cl. | *Pisidium* sp. | 27 |
| | | d. | *Somatochlora* sp. | 1 |
| | | mayflies (m.) | unidentified Baetidae | 1 |
| | | s. | *Gyrallus* sp. | 10 (13 e.) |
| | 5' | a. | *G. lacustris* | 19 |
| | | c. | *Chironomus* sp. | 13 |
| | | | *Tantytarsus* sp. | 1 |

*e. = empty shell

TABLE 6. (cont.)

| DATE | DEPTH | ORGANISM GROUP | IDENTIFICATION | NUMBER |
|---|---|---|---|---|
| | | cl. | *Pisidium* sp. | 14 |
| | | d. | *Somatochlora* sp. | 6 |
| | | l. | *Glossophonia heteroclita* | 1 |
| | | s. | *Gyrallus* sp. | 2 (5 e.)* |
| | 10' | a. | *G. lacustris* | 10 |
| | | c. | *Chironomus* sp. | 3 |
| | | | *Tanytarsus* sp. | 2 |
| | | cl. | *Pisidium* sp. | 26 |
| | | l. | *Glossophonia heteroclita* | 1 |
| | | s. | *Gyrallus* sp. | 1 (7 e.) |
| | 20' | c. | *Tanytarsus* sp. | 5 |
| | | | unidentified Tanypodinae pupae | 1 |
| | 30' | c. | *Chironomus* sp. | 28 |
| | | | *Phaenopsectra* sp. | 8 |
| | | | unidentified female adult | 1 |
| 9/7/73 | 1' | a. | *G. lacustris* | 12 |
| | | cl. | *Pisidium* sp. | 14 |
| | | s. | *Gyrallus* sp. | 2 |
| | | w. | *Lumbriculus* sp. | 1 |
| | 5' | a | *G. lacustris* | 5 |
| | | c. | *Chironomus* sp. | 3 |
| | | | *Paratanytarsus* sp. | 1 |
| | | cl. | *Pisidium* sp. | 20 |
| | | s. | *Gyrallus* sp. | 2 (4 e.) |
| | 10' | a. | *G. lacustris* | 10 |
| | | cd. | *Banksiola* sp. | 1 |
| | | cl. | *Pisidium* sp. | 28 |
| | | ceratopogonids (cp.) | unidentified | 5 |
| | | s. | *Gyrallus* sp. | 2 (8 e.) |
| | 20' | c. | *Chironomus* sp. | 13 |
| | | | *Polypedium* | 2 |
| | | | *Procladius* sp. | 1 |
| | | s. | *Gyrallus* sp. | 1 (e.) |
| | 30' | c. | *Chironomus* sp. | 6 |
| | | | *Phaenopscetra* sp. | 6 |
| | | | unidentified pupae incomplete | 3 |
| | | w. | *Ilyodrilus* sp. | 15 |

*e. = empty shell

TABLE 6. (cont.)

| DATE | DEPTH | ORGANISM: GROUP | ORGANISM: IDENTIFICATION | ORGANISM: NUMBER |
|---|---|---|---|---|
| 9/17/73 | 1' | a. | *G lacustris* | 6 |
| | | c. | *Phaenopsectra* sp. | 1 |
| | | cl. | *Pisidium* sp. | 12 |
| | | s. | *Gyrallus* sp. | 1 (e.)* |
| | 5' | a. | *G. lacustris* | 7 |
| | | cl. | *Pisidium* sp. | 1 |
| | | s. | *Gyrallus* sp. | 1 (e.) |
| | 10' | a. | *G. lacustris* | 3 |
| | | cl. | *Pisidium* sp. | 1 |
| | | s. | *Gyrallus* sp. | 2 (e.) |
| | 20' | c. | *Cryptochironomus digitatus* | 1 |
| | 30' | c. | *Chironomus* sp. | 2 |
| | | | *Phaenopsectra* sp. | 1 |
| | | w. | *Peloscolex* sp. | 1 |

*e. = empty shell

TABLE 7.

BIG LAKE

BENTHIC MACROINVERTEBRATES

| DATE | DEPTH | ORGANISM<br>GROUP | <br>IDENTIFICATION | <br>NUMBER |
|---|---|---|---|---|
| 9/10/73 | 12.6 m | chironomids (c.) | *Chironomus* sp. | 4 |
| | 13 m | c. | *Chironomus* sp. | 2 |
| | | clams (cl.) | *Pisidium* sp. | 1 |
| | 10 m | c. | *Chironomus* sp. | 21 |
| | | | *Phaenopsectra* sp. | 31 |
| | | | *Procladius* sp. | 3 |
| | | | *Tanytarsus* sp. | 2 |
| | | cl. | *Pisidium* sp. | 3 |
| | | snails (s.) | *Gyrallus* sp. | 5 |

TABLE 8.

SOUTH ROLLY LAKE

BENTHIC MACROINVERTEBRATES

| | | ORGANISM | | |
|---|---|---|---|---|
| DATE | DEPTH | GROUP | IDENTIFICATION | NUMBER |
| 8/22/73 | 3 m | chironomids (c.) | *Monodiamesa bathyphilia* | 1 ecdysis |
| | | | *Protanypus* sp. | 1 |
| | | | *Stictochironomus rosenschöldi* | 5 |
| | | | *Tanytarsus* sp. | 1 |
| 8/22/73 | 7.5 m | c. | *Monodiamesa bathyphilia* | 1 |
| | | | *Protanypus* sp. | 1 ecdysis |
| | | | *Stictochironomus rosenschöldi* | 17 |
| | | | *Tanytarsus* sp. | 31 |
| | | mites (m.) | unidentified | 1 |
| | | worms (w.) | unidentified tubificids | pieces |

TABLE 9.

MILO I LAKE

BENTHIC MACROINVERTEBRATES

| | | ORGANISM | | |
|---|---|---|---|---|
| DATE | DEPTH | GROUP | IDENTIFICATION | NUMBER |
| 8/22/73 | 9.75 m | chironomids (c.) | *Cricotopus* (?) sp. | 1 |
| | | | *Heterotrissocladius* (?) sp. | 2 |
| | | | *Stictochironomus rosenschöldi* | 3 |
| | | | *Tanytarsus* sp. | 17 |
| | | mites (m.) | unidentified | 1 |
| | | worms (w.) | unidentified Lumbriculidae | 1 |
| 8/22/73 | 3 m | amphipods (a.) | *Hyalella azteca* | 2 |
| | | c. | *Cryptochironomus digitatus* | 1 |
| | | | *Tanytarsus* sp. | 1 ecdysis |
| | | w. | *Peloscolex* sp. | 1 |

Considering the chironomids which became the focus of this study, two distinct groups of lakes are identified. Harding, Milo 1, and South Rolly Lakes contain known indicators of oligotrophy (Saether, 1974), *Stictochironomus rosenschöldi* and *Monodiamesa bathyphila* (these were not reared but identified from larvae by Dr. Saether). *S. rosenschöldi* is an indicator of mesotrophy in other parts of the world (Widerholm, 1973) which points out the need to study here the ecology of the species which occur and are known elsewhere.

The second group of lakes, Johnson, Memory and Big Lakes, contains a different and less varied association of chironomids. This could be attributed to inexperience on the part of the technician picking the samples from Memory and Johnson Lakes and to the large size of the screens used for processing those samples; however, the Big Lake samples were taken by the same methods used on the three lakes of the other group.

The lack of any reared chironomids from the Anchorage lakes and the lack of chironomid larvae which are identified to species from Big, Memory and Johnson Lakes does not allow the assignment of a specific trophic state to these three lakes on the basis of indicator chironomids.

The rearing effort at Harding Lake in the summer of 1974 has resulted in the identificiation of the following additional chironomids to species.

<u>Tanypodinae</u>

*Clinotanypus pinguis* (Loew)
*Procladius (Psilotanypos) bellus* (Loew)
*Procladius (Procadius) freemani* (Subl.)

<u>Chironominae</u>

*Einfeldia pagana* (Meig.)
*Parachironomus* sp. n. near *swammerdami*
*Chironomus* cf. *hyperboreus* (Staeg.)
*Chironomus* sp. n.
*Chironomus* sp. (female) probably different from the two above.

Unfortunately the ecology of the reared species is not well known enough to allow their use as indicator organisms.

The new species of *Parachironomus* is suspected to be in some association with the molluscs as is often reported for this genus. This is suspected because the one reared was the only one collected by our benthos sampling methods while this chironomid is one of the most numerous in fish stomach contents from this lake. The other new species, that of *Chironomus*, and the other two of this genus reared as well as the *Einfeldia pagana*, were collected from mud tubes attached to *Chara* sp. which was growing thickly in 4-5 m of water offshore near Station 7.

The genus *Chironomus* is often associated with eutrophic conditions but to assume that this area of the lake is eutrophic, or that the lake is eutrophying would probably be an incorrect interpretation of the evidence. This genus of chironomid is adapted for life in low-oxygen waters both by ventral gills and the presence of hemoglobin in the blood. Photosynthetic generation of oxygen in this *Chara* "meadow" was visible to skin divers as streams of bubbles on bright sunny days. The presence of the particular association of chironomids is probably due to their ability to tolerate the local low oxygen conditions when this "meadow" is respiring at night or in reduced light conditions. This provides a good habitat for this association wherein competition with less tolerant species which are perhaps more indicative of lake trophic conditions is eliminated. Of course, the chironomids involved may just be unaffected by the toxic substances assumed to be produced by *Chara* (Darby, 1962).

# CONCLUSIONS

At the initiation of this project, it was assumed that lakes receiving heavy recreational pressure would prove to be culturally eutrophied. The investigator now has some preliminary evidence that this is happening in at least one lake in interior Alaska. Unfortunately, this lake was not chosen for the investigations of this project.

The lakes chosen for the project all seem to be oligotrophic or, at best, the data is inconclusive. It must be pointed out that the finding of chironomids indicative of oligotrophy is not conclusive evidence that a lake is oligotrophic, but may indicate only that it has been oligotrophic. What one is searching for in a study like this are indicators of eutrophy which can provide conclusive evidence that a lake is becoming eutrophied. This presents a difficulty in studying oligotrophic lakes because all or nearly all of the chironomids living in the lake must be reared to eliminate the possibility of finding a species indicative of eutrophy. The discovery of new species, which is unavoidable in a relatively unstudied area like Alaska, presents additional problems because the ecology is then not previously known and its use as an indicator species is not possible.

From evidence such as the high-standing crop of tubificid worms in certain areas of Harding Lake, as well as the high hydrophyte biomass (LaPerriere and Robertson, 1973), the investigator has come to the conclusion that the trophic state system of lake classification may not be valid for the Alaskan subarctic and arctic. A paper on this topic was presented at the nineteenth triennial congress of the Societas Internationalis Limnologiae in August 1974 (LaPerriere *et al.*).

## REFERENCES


Blackwell, M.J. (1965). Surficial geology and geomorphology of the Harding Lake area, Big Delta quadrangle, Alaska. Unpublished M.S. thesis. Fairbanks, Alaska, Library, University of Alaska. 91 pp.

Brundin, L. (1949). Chironomiden und andere bodentiere der suschwedischen urgebirgsseen. Institute of Freshwater Research. Drottmingholm. Report No. 30:1-914.

Curry, L.L. (1962). A survey of environmental requirements for the midge (Diptera: Tendipedidae) in *Biological Problems in Water Pollution Third Seminar*. Public Health Service Publication No. 999-WP-25. Cincinnati, Ohio. 127-141.

Darby, R.E. (1962). Midges associated with California rice fields, with special reference to their ecology (Diptera: Chironomidae). *Hilgardia* 32:1-206.

Deevey, E.S., Jr. (1941). Limnological studies in Connecticut. VI. The quantity and composition of the bottom fauna of thirty-six Connecticut and New York Lakes. *Ecological Monographs* 11:415-455.

Guymon, G.L. (1974). Personal communication.

Hamilton, A.L.; Saether, O.A.; and Oliver, D.R. (1969). A classification of the nearctic Chironomidae. Fisheries Research Board of Canada Technical Report No. 124. 42 pp.

Hutchinson, G.E. (1957). *A Treatise on Limnology*. Volume 1. John Wiley and Sons, Inc., 1015 pp.

Johnson, P., and Hartman, C. (1971). Environmental Alaska of Alaska. 2nd edition. University of Alaska, College, Alaska, 111 pp.

Lake Tahoe Area Council (1971). Eutrophication of Surface Waters - Lake

Tahoe. Water Pollution Control Research Series 16010 DSW 05/71 USEPA. Washington, D.C. p. 55-56.

LaPerriere, J D.; Casper, L.A.; and Payne, F.C. (1974). Difficulties in assigning a trophic state to a deep subarctic lake. *Verh. Internat. Verien. Limnol.* 19. (In press).

LaPerriere, J.D., and Robertson, B.R. (Compilers) (1973). The distribution and succession of aquatic vascular plant communities in relation to physical-chemical characteristics of various lakes and ponds of the Tanana Valley. Central Alaska. Termination report. Institute of Water Resources, University of Alaska, Fairbanks, Alaska. 17 pp.

Saether, O.A. (1974). Nearctic chironomids as indicators of lake typology. *Verh. Internat. Verein. Limnol.* 19. (In press).

Watson, C.; Branton, C.; and Newman, J. (1971). Climatic Characteristics of Selected Alaskan Locations. *Technical Bulletin #2.* Institute of Agricultural Science, University of Alaska, Fairbanks, Alaska.

Wiederholm, T. (1973). Bottom fauna as an indicator of water quality in Sweden's large lakes. *AMBIO* 2:107-110.

BENTHOS IDENTIFICATION BIBLIOGRAPHY

Burch, J.B. (1972). Freshwater Sphaeriacian Clams (Mollusca: Pelecypoda) of North America Biota of Freshwater Ecosystems Identification Manual No. 3. USEPA, Water Pollution Control Research Series 18050 ELD03/72. 31 pp.

Curry, L.L. (1958). Larvae and Pupae of the Species Cryptochironomus (Diptera) in Michigan. *Limnology and Oceanography* 3(4):427-442.

Edmondson, W.T. (1959). *Freshwater Biology.* Second Edition. John Wiley & Sons, Inc., New York, London. 1248 pp.

Greenberg, B. (1974). Manual for the identification of the nuisance midges of the metropolitan sanitary district of Greater Chicago. Research and Development Department of the Metropolitan Sanitary District of Greater Chicago. 16 pp.

Holsinger, J.R. (1972). The Freshwater Amphipod Crustaceans (Gammaridae) of North America. Biota of Freshwater Ecosystems Identification Manual No. 5. USEPA, Water Pollution Control Research Series 18050 ELD04/72, 89 pp.

Klemm, D.J. (1972). Freshwater Leeches (Annelida: Hirudinea) of North America. Biota of Freshwater Ecosystems Identification Manual No. 8. USEPA, Water Pollution Control Identification Series 18050 ELD05/72. 53 pp.

Mason, W.T., Jr. (1968). An introduction to the identification of Chironomid larvae. Publication of the Federal Water Pollution Control Administration, U.S. Department of the Interior, Cincinnati. 80 pp.

Pennak, R.W. (1953). *Freshwater Invertebrates of the United States.* The Ronald Cress Company, New York. 769 pp.

Saether, O.A. (1966-1967). Notes on the Bottom Larva of Two Small Lakes in Northern Norway. *Nytt Magasin For Zoologi.* 14:96-124.

Saether, O. A. (1973). Taxonomy and ecology of three new species of *Monodiamesa* Kieffer, with keys to Nearctic and Palaearctic species of the genus (Diptera: Chironomidae). *J. Fish Res. Board Can.* 30:665-679.

Stewart, P.L., and Loch, J.S. (1973). A guide for the identification of two subfamilies of larval Chironomidae: the Chironominae and Tanypodinae found in benthic studies in the Winnipeg River in the vicinity of Pine Falls, Manitoba in 1971 and 1972. Environment Canada. Fisheries and Marine Service. Technical Report Series No. CEN/T-73-12. 46 pp.

Usinger, R.L. (1971). *Aquatic Insects of California.* University of California Press. Berkeley, Los Angeles, London. 508 pp.

## Presentations

LaPerriere, J.D., 1974. *The Benthos of Harding Lake, Interior Subarctic Alaska.* The Midwest Benthological Society, 22nd annual meeting, March 27-29, 1974, Cincinnati, Ohio.

LaPerriere, J.D. (1974). *Difficulties in Assigning a Trophic State to a Deep, Subarctic Lake.* XIX Congress of Societas Internationalis Limnologiae, August 22-29, 1974. Winnipeg, Manitoba, Canada.

LaPerriere, J.D. (1974). Short presentation on Harding Lake in the workshop session. *Effects of a Lake's Watershed on Water Quality* at the Conference on Lake Protection and Management, October 21-23, 1974, Madison, Wisconsin.

## Papers

LaPerriere, J.D.; Casper, L.A.; and Payne, F.C. (1974). Difficulties in assigning a trophic state to a deep, subarctic lake. *Verh. Internat. Verein. Limnol.* 19. (In press).

# APPENDIX

## APPENDIX

## KEY TO THE CHIRONOMIDS OF MEMORY AND JOHNSON LAKES NEAR ANCHORAGE, ALASKA

This key is designed for use by Alaska Fish and Game, Palmer, personnel and applies to the above-named lakes only. Figure 1 illustrates the general body form of chironomids (non-biting midges) and points out the taxonomically important features.

1. Posterior prolegs long and V-shaped (Fig. 2), head large and light colored, one pair of eyespots (Fig. 3). . . . . . . *Procladius* sp.

1. Posterior prolegs shorter, head usually dark color (at least yellow), usually with two distinct pair of eyespots. . . . . . . . . . . 2.

2. Tubercle at base of antenna large, the first antennal segment long and curved, Lauterborn organs usually very long and visible on petiole (Fig. 4). . . . . . . . . . . . . . . . . . . . . *Tanytarsus* sp. [If these organs have shorter stalks and look like lilies (Fig. 5). . . . . . . . . . . . . . . . . . . . . . *Paratanytarsus* sp.]

2. No prominent tubercle at the base of the antenna, the first antennal segment not long and curved, Lauterborn organs if present not opposite with long petiole. . . . . . . . . . . . . . . . . . . . . . . 3.

3. With ventral gills (Fig. 1). Trifid middle tooth on hypostomial plate (Fig. 6). . . . . . . . . . . . . . . . . . . *Chironomus* sp.

3. Without ventral gills . . . . . . . . . . . . . . . . . . . . . . 4.

To follow through the rest of this key it is necessary to cut off the head capsule of the larva and mount it with the mouthparts facing up on a slide. Any mounting medium with some clearing properties such as Turtox's CMC 9 is suitable.

4. With an even number of teeth on the hypostomial plate and with the four middle teeth all nearly the same height (Fig. 7) . . *Phaenopsectra* sp.

4. With an odd number of teeth on the hypostomial plate. . . . . . . 5.

5. With a lighter middle tooth (with dark sides) and five oblique dark teeth on each side (Fig. 8) . . . . . . *Cryptochironomus digitatus*.

5. With a middle tooth that is as dark as the others on the hypostomial plate . . . . . . . . . . . . . . . . . . . . . . . . . . . 6.

6. With a median tooth that is taller than the rest of the teeth on the hypostomial plate and with the fourth tooth out from the middle smaller than those on either side of it (Fig. 9). . . *Einfeldia* sp.

6. With the paralabial plates nearly square and deeply scalloped on the anterior edge (Fig. 10) . . . . . . . . . . . . *Dicrotendipes* sp.

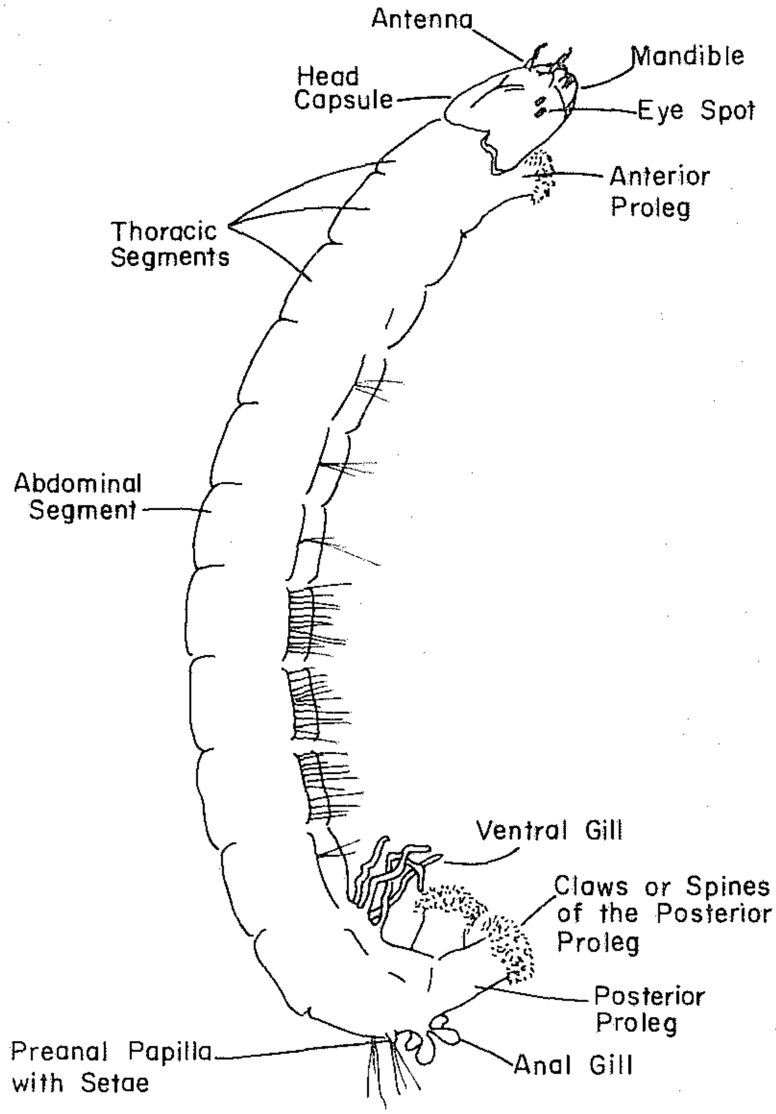



*Figure 1: General Chironomid Larva - illustrating important taxonomy. (after Mason)*

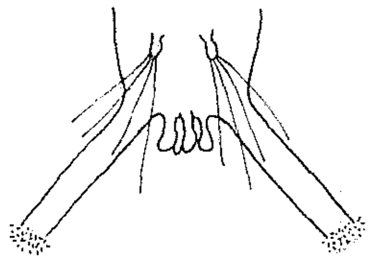


*Figure 2: Top view of Procladius sp. - posterior end.*

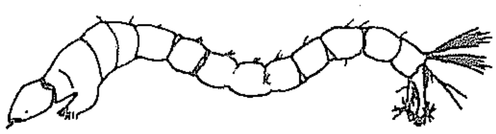


*Figure 3: Procladius sp. (after Mason).*

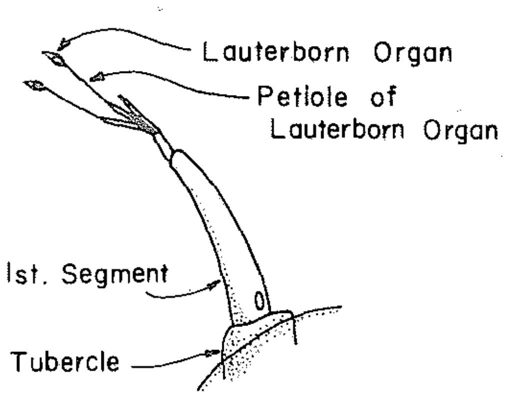



*Figure 4: Antenna of Tanytarsus sp..*

*Figure 5: Antenna of Paratanytarus sp..*

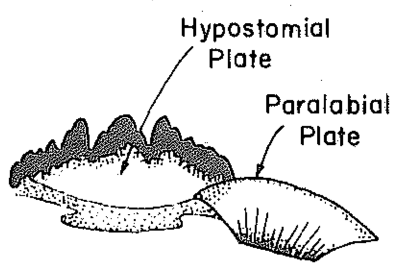



*Figure 6: Hypostomial plate and left paralabial plate of Chironomus sp..*

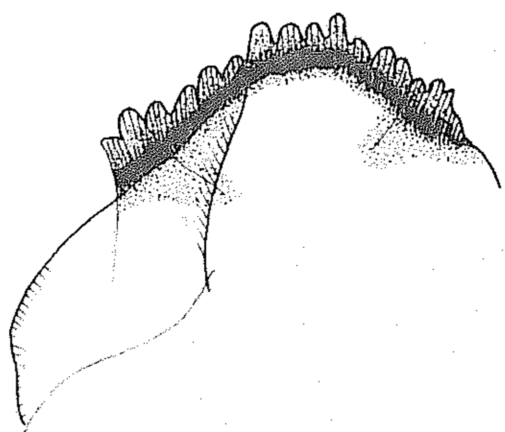


*Figure 7: Hypostomial plate and right paralabial plate of Phaenopsectra sp..*

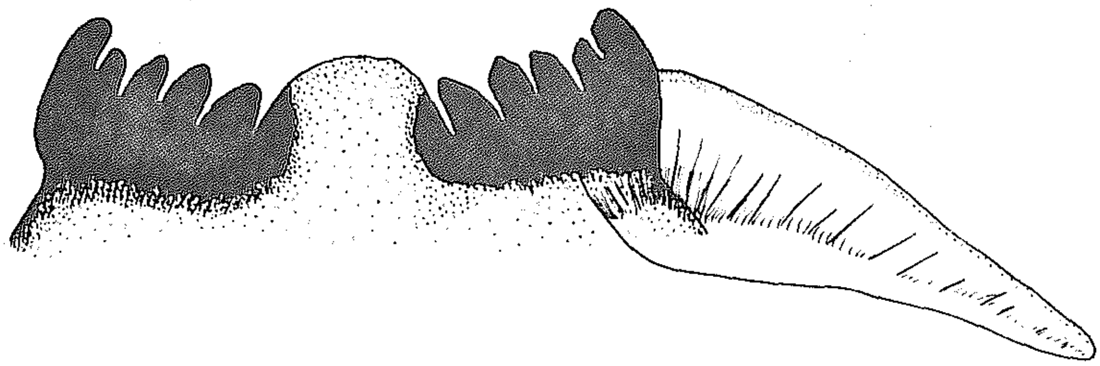


*Figure 8: Hypostomial plate and left paralabial plate of Chriptochironomus digitatus.*

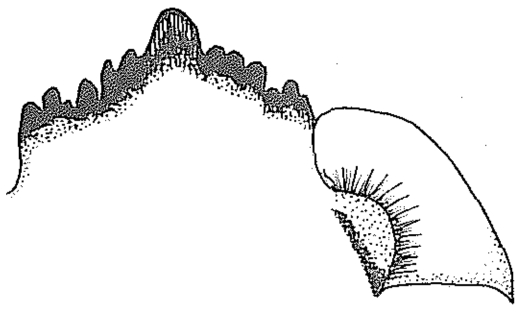


*Figure 9: Hypostomial plate and left paralabial plate of Einfeldia sp..*

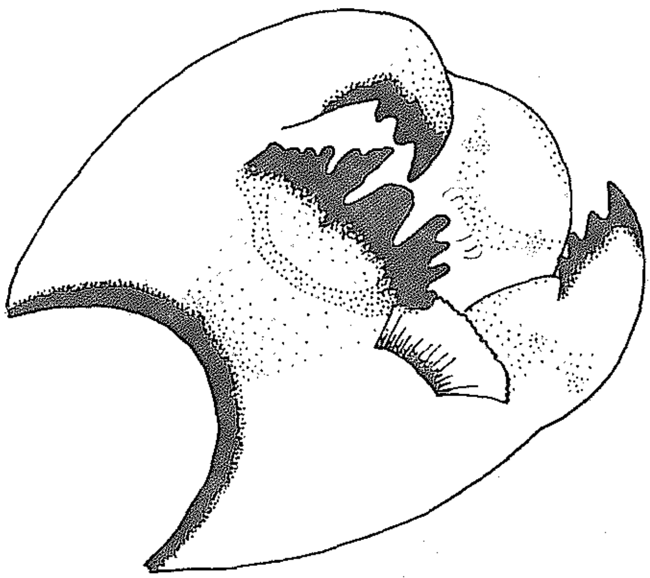


*Figure 10: Hypostomial plate and left paralabial plate of Dicrotendipes sp..*